Accelerometer Data Analysis using Python

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Introduction

- Accelerometer is a device used to measure the acceleration or vibrations of a motion.
- The data provided by an accelerometer is three-dimensional and can be used in data-driven applications for solving problems like fall detection and health monitoring.
- I will take you through the task of Accelerometer Data Analysis using Python.

Tools used:

Accelerometer Data Analysis

- We first need to collect data collected by an accelerometer. As an accelerometer collects three-dimensional data, it's essential to have data about the x, y, and z axes in our dataset with respect to a particular time period.
- I found an ideal dataset for this task.
- Analyze accelerometer data using the Python programming language.

Microsoft Excel
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Steps involved

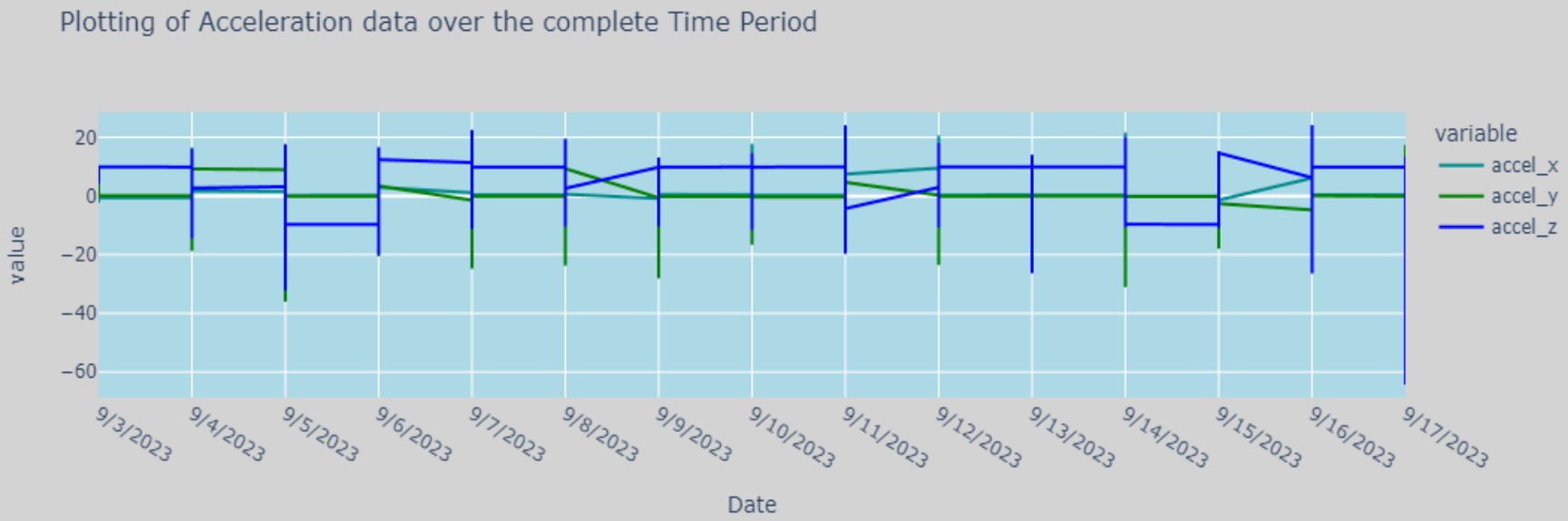
- I will start the task of accelerometer data analysis by importing the necessary Python libraries and the dataset, This includes the following libraries
  - Plotly for plotting
  - Pandas for Data manipulation
  - Numpy for numerical computations
  - Visualizing a line plot with time on the x-axis and accelerometer data on the y-axis

```
import plotly.express as px
import pandas as pd
import plotly.graph_objects as go
import numpy as np

data = pd.read_csv("C:\\Users\\LENOVO\\Downloads\\Acc-Data\\Acc Data\\accelerometer_data.csv")
print(data.head())
```

```
        Date      Time   accel_x   accel_y   accel_z
0  9/3/2023  23:35:16 -1.838747  3.543418  9.126697
1  9/3/2023  23:35:31  1.110910  1.810017  9.634268
2  9/3/2023  23:35:47  8.829816  0.833182  4.663905
3  9/3/2023  23:36:52 -0.852336 -0.124498  9.787497
4  9/3/2023  23:37:44 -0.900220 -0.095768  9.835381
```

Visualizing a line plot

```
color_map = {
    "accel_x": "darkcyan",
    "accel_y": "green",
    "accel_z": "blue",
}
fig = px.line(data, x="Date",
              y=["accel_x", "accel_y", "accel_z"],
              title="Plotting of Acceleration data over the complete Time Period", color_discrete_map=color_map)
fig.update_layout(
    plot_bgcolor="lightblue",  # Specify the desired background color
    paper_bgcolor="lightgray"   # Specify the color of the paper or canvas
)

fig.show()
```



Pattern – Avg. acceleration

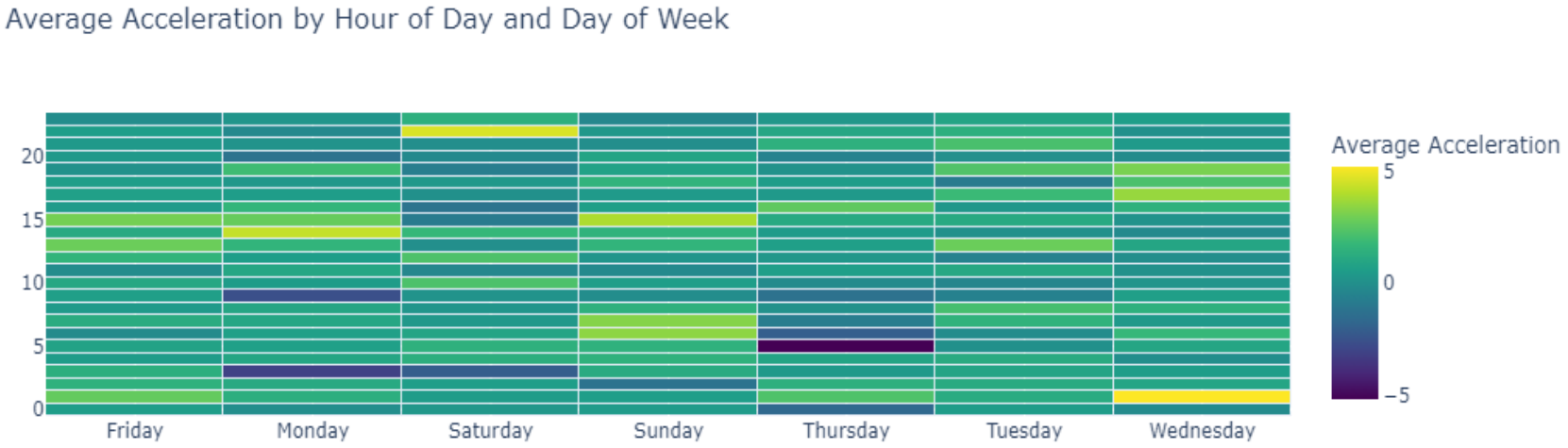
Now let's have a look at the average acceleration values by the hour of day and day of the week, which can help us identify any patterns or trends in the data.

```
data["hour_of_Day"] = pd.to_datetime(data["Time"]).dt.hour
data["day_of_week"] = pd.to_datetime(data["Date"]).dt.day_name()

day_order = ["Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday", "Sunday"]

agg_data = data.pivot_table(index="hour_of_Day", columns="day_of_week",
                            values=["accel_x", "accel_y", "accel_z"],
                            aggfunc="mean")

# Create a heatmap
fig = go.Figure(go.Heatmap(x=agg_data.columns.levels[1],
                           y=agg_data.index,
                           z=agg_data.values,
                           xgap=1, ygap=1,
                           colorscale="Viridis",
                           colorbar=dict(title="Average Acceleration")))
fig.update_layout(title="Average Acceleration by Hour of Day and Day of Week")
fig.show()
```

HeatMap Analysis

Heat map generated , Which gives the highest and lowest values spread across a week based on

- Average hours of the day
- Average day of the week
- For better visualization of the variables.



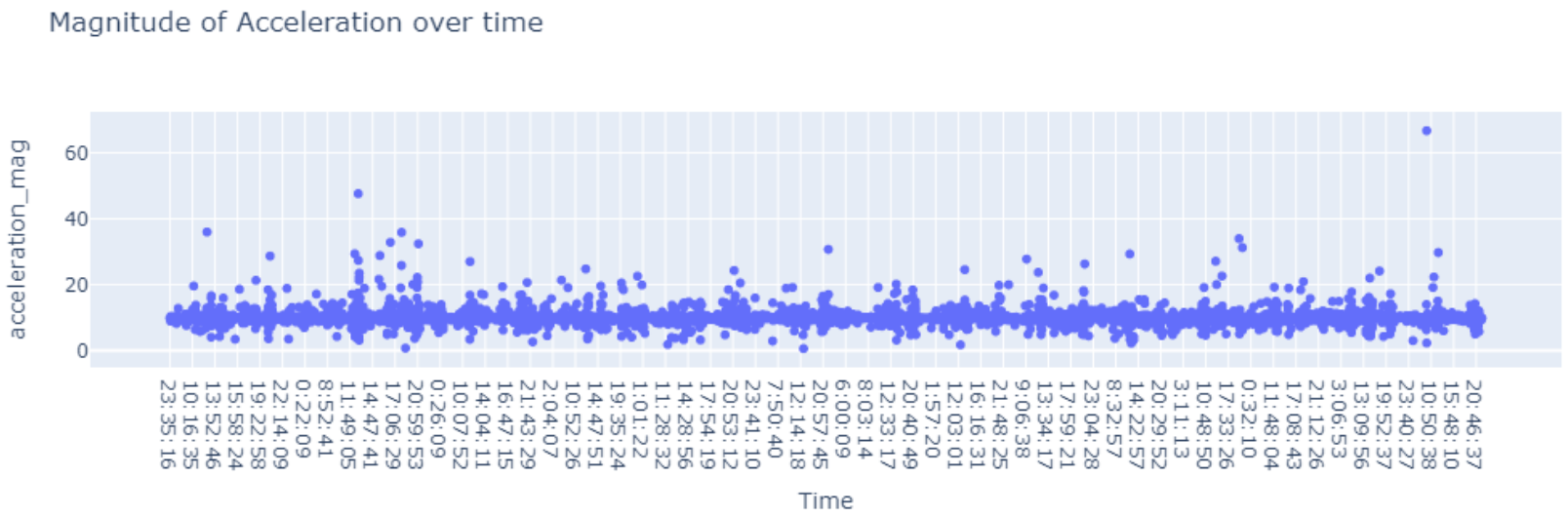
Magnitude–Acceleration Vector Linear

Now let's create a new feature to represent the magnitude of the acceleration vector using numpy linear algorithm :

```
46 data['acceleration_mag'] = np.linalg.norm(data[['accel_x', 'accel_y', 'accel_z']], axis=1)
```

scatter plot of the magnitude of acceleration over time:

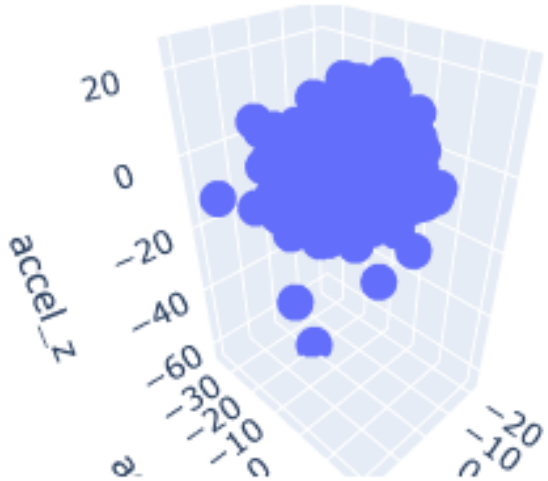
```
48 fig = px.scatter(data, x='Time',
49                  y='acceleration_mag',
50                  title='Magnitude of Acceleration over time')
51 fig.show()
52 #to create a scatter 3D Plot
53 fig = px.scatter_3d(data, x='accel_x',
54                     y='accel_y',
55                     z='accel_z',
56                     title='Acceleration in 3D space')
57 fig.show()
```



Magnitude –Acceleration Vector 3D

3D scatter plot where the x, y, and z axes represent the acceleration in each respective direction:

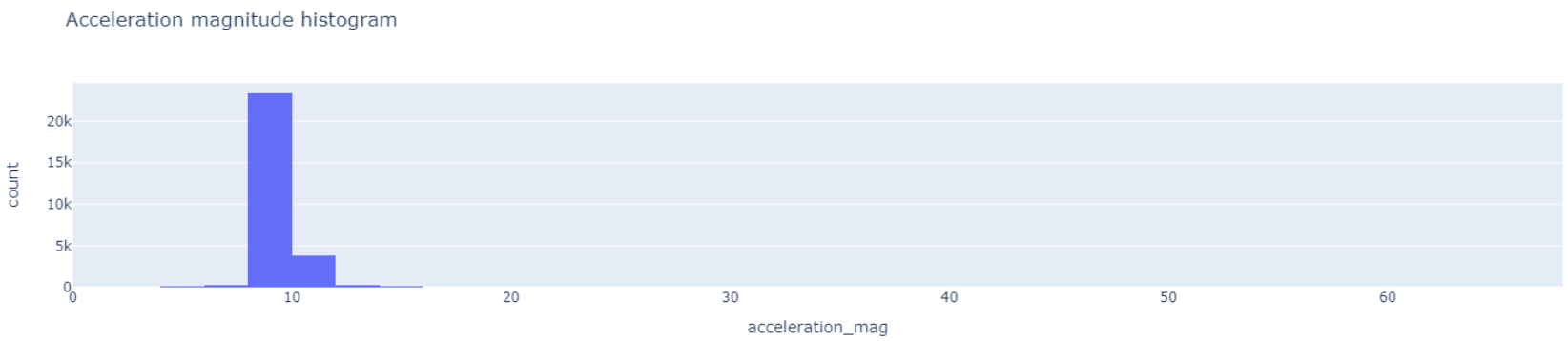
```
59 fig = px.scatter_3d(data, x='accel_x',
60                     y='accel_y',
61                     z='accel_z',
62                     title='Acceleration in 3D space')
63 fig.show()
```



Magnitude –Acceleration Vector Histogram

Visualize the distribution of the magnitude of acceleration

```
65 fig = px.histogram(data,
66                     x='acceleration_mag',
67                     nbins=50, title='Acceleration magnitude histogram')
68 fig.show()
```



Summary

- Accelerometer is a device used to measure the acceleration or vibrations of a motion.
- The data provided by an accelerometer is three-dimensional and can be used in data-driven applications for solving problems like fall detection and health monitoring.

Thank you